Simulation Controls

Several keys on the main keyboard control flight systems, visual systems, and the simulation itself. Those you will use during your first flight are described in this section.

To view your surroundings:

When you fly according to Visual Flight Rules, you will need to look around frequently to observe traffic, weather, and obstacles. The view selector lets you choose from nine viewing directions. To use the view selector, press the View key (Scroll Lock) located over the upper right corner of the numeric keypad and then any one of the keys on the numeric keypad (see Figure 17). Do not press the keys simultaneously.

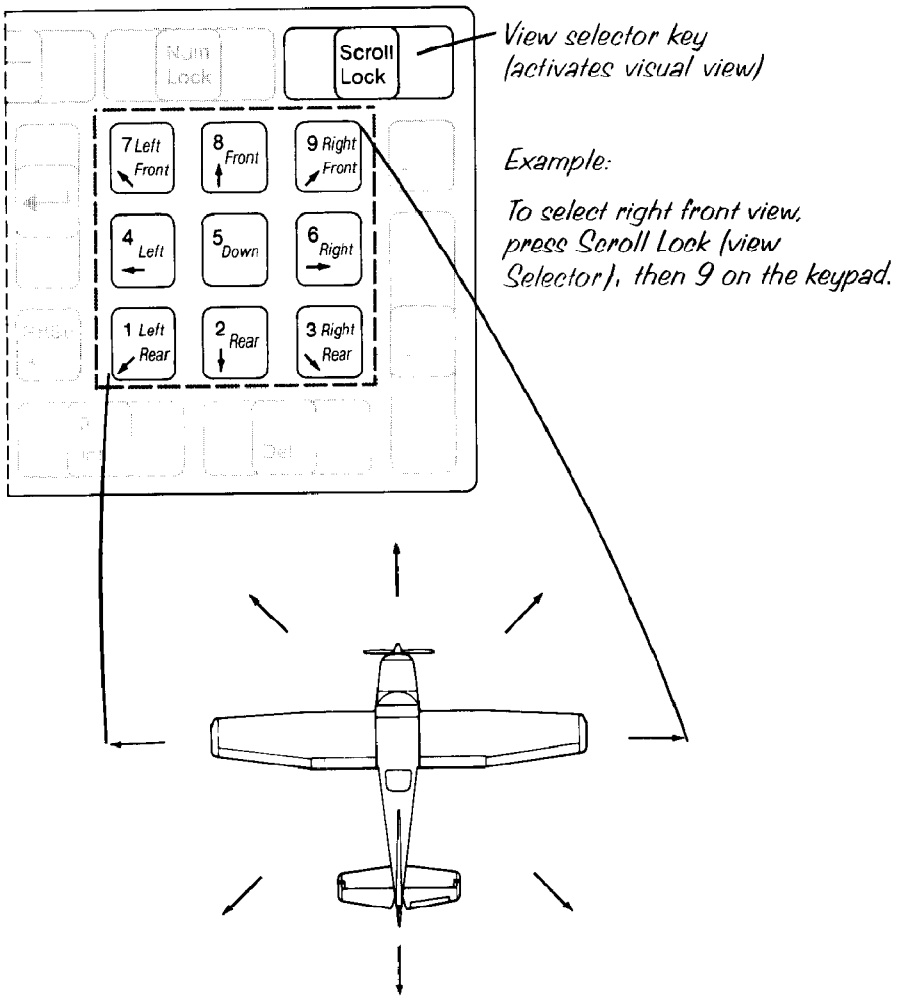


Figure 17. View Selector Controls for the PC

The keys bear a logical relationship to the selected view. For example, pressing Scroll Lock and the *2* key displays the view you would see if you could look directly behind you (notice the tail). Pressing the Scroll Lock key and the *9* key instead displays the right front view (notice the front part of the wing). Pressing Scroll Lock and the *5* key displays the downward view (notice the landing wheel strut). You may also adjust your selected view up or down, by pressing the Backspace or Enter key respectively.

To use radar:

Radar gives you a top-down view with an adjustable range or zoom. This gives you an overview of the area in which you are flying. A small symbol indicates your position. You can also use radar view to guide yourself around airports and to navigate. The image it presents is unrealistically accurate and is more like a map display.

To select radar view, press the Radar key (Num Lock). Press the + or − keys at the top of the main keyboard to zoom in and out of the radar's range. To return to the three-dimensional display, press the Scroll Lock key.

To select a new viewing direction after switching from radar to three-dimensional view, press the Scroll Lock key again and a view direction key.

The Pause key (*P*) suspends simulation. Pressing the *P* key a second time resumes simulation where you left off. You will find this feature particularly helpful for reading ahead in the manual if you lose control of your plane.

Secondary Aircraft Controls

The primary flight controls are the only controls needed to fly the plane in easy flight mode (the mode you are in when you begin the program). The secondary controls are used to navigate, control the engine, and control the simulator itself. Their positions on the panel and functions are described in previous sections. A description of how to use these follows. If this is your first flight, you may want to return to this section later.

Flaps

Flaps are movable panels on the inboard trailing edges of the wings. They are hinged so they can be extended downward into the flow of air beneath the wings to increase lift (upward force) and *drag* (rearward pull). Their primary purpose is to permit a slower airspeed and steeper angle of descent during a landing approach. They can also be used to shorten takeoff distance or decrease stall speed on landing approach.

To slow your plane for landing:

The row of odd-numbered Function keys, F1 to F9, controls the flaps (see Figure 18). The flaps have 5 positions: UP, 10 degrees, 20 degrees, 30 degrees, and 40 degrees. Flaps in the 40-degree position are totally extended. In the UP position, they are totally retracted. The F1 key retracts the flaps, and the F9 key extends the flaps 40 degrees.

Extending and retracting the flaps affects the plane's performance considerably. Lowering the flaps increases both lift and drag. This increases glide angle, which is particularly useful if you are flying too high on an approach and want to increase your rate of descent. Airspeed can be reduced by extending the flaps.

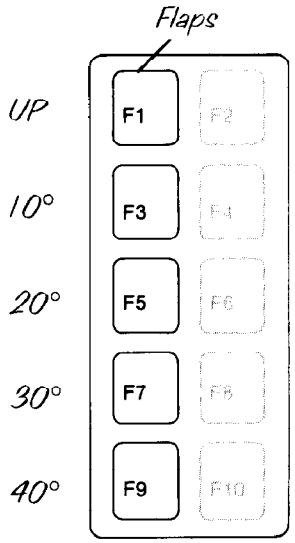


Figure 18. Flap Controls for the PC

Elevator Trim

The control yoke is directly connected to the airfoils it controls. Different flight attitudes put different pressure on the airfoils. These variations also change the pressure on the yoke. The pilot must counteract these forces to keep the airfoils in their proper positions. Applying steady pressure on the yoke for hours would be fatiguing. *Trim* is used to counteract these forces and relieve the pilot from applying constant pressure on the yoke.

To counteract forces on the yoke:

Flight Simulator provides elevator trim controls. The 7 and 1 keys on the numeric keypad control elevator trim. Pressing the 7 key adjusts the trim downward. Pressing the 1 key adjusts the trim upward. The elevator trim position indicator shows elevator trim position, with the "U" representing the up position and the "D" representing the down position (see Figure 19). Remember these keys as the upper left and lower left keys of the control yoke.

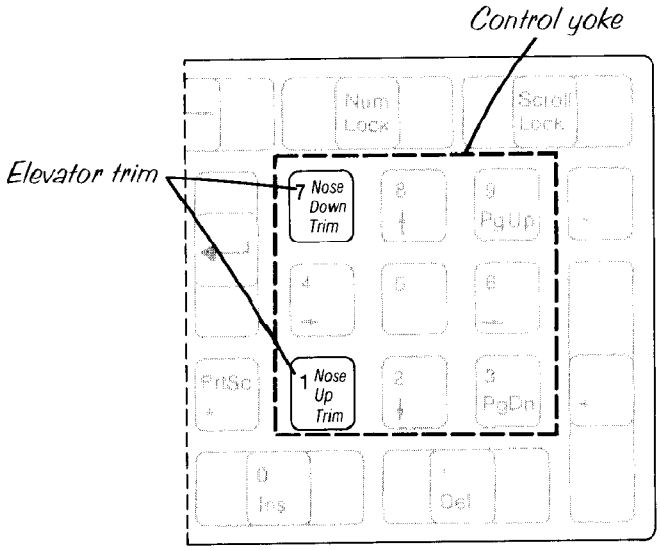


Figure 19. Elevator Trim Controls for the PC

Carburetor Heat

The Heat key (H) is the carburetor heat toggle switch. The carburetor heat indicator on the instrument panel shows whether carburetor heat is on or off.

Carburetor heat is used to preclude icing or clear ice that has already formed in the carburetor. Apply carburetor heat for a few seconds on landing approach to avoid ice-caused engine failure.

Magneto Switch and Mixture Full Lean Control

The Magneto key (M) is the magneto switch. After you press the M key, enter one of the following numbers (in the top row of keys on the main keyboard) to indicate magneto setting.

Number	*Result*	
1	OFF	Magnetos off
2	L	Left magneto on
3	R	Right magneto on
4	B	Both magnetos on
5	ST	Start engine, then both magnetos on
0	LN	Mixture full lean (engine turn-off)

Lights

The Lights key (L) turns on the running and instrument lights. *Running lights* are lights on the tips of each wing – red on the pilot's left, green on the right – that help others identify your heading. Instrument panel lights illuminate individual instruments on the instrument panel, so you can see them at night. You must turn on the running and instrument panel lights for night flight. It's not advisable to fly with your lights on during the day. If you do, when night arrives you may find that a bulb on an important instrument has burned out. Bulbs are replaced during refueling and servicing stops.

Navigation Radio

The NAV radio is an important navigational aid. It is used to tune in VOR radio beacons, so you can fly toward or away from them. Two NAV radios are provided so you can tune in two VOR beacons at once. This is useful for doing cross-checks of your position.

To tune into VOR beacons:

You must set the NAV radio to the VOR frequency to receive the appropriate signal. On a real aircraft, two knobs are used to set the frequency. One sets the full megahertz frequencies (121, 122, 123, etc.), and the other sets the fractional frequencies in 50 kHz increments (.00, .05, .10, etc.). Many new radios are 720-channel models with 25 kHz separations, but none of these intermediate frequencies are implemented on Flight Simulator.

To set the NAV radio to a particular frequency, press the NAV key (*N*), followed by the radio number (1 for NAV1 and 2 for NAV2). Then press the + or − keys (on the main keyboard, not the numeric keypad) to advance or move back the current setting until you reach the desired MHz frequency. To set the fractional frequency (e.g., .00, .05, .10, etc.), press the *N* key twice, in rapid succession, then press either the + or − key until you reach the appropriate setting. Pressing the radio number after the *N* key is only necessary if you want to tune a NAV radio other than the one you most recently tuned.

For example, to advance from 121 to 126 MHz, press *N* + + + + +. To advance from .35 to .55, press *NN* + + + +. For more information on using the NAV radio, see "Navigational Aids."

The NAV1 radio is also used to tune in ILS localizer and glideslope. For more information on instrument flying, see "Advanced Flight Techniques." For detailed information, consult a flight training manual.

Omni-Bearing Indicator

The OBI is used with the NAV radio to tune into VOR (Very high frequency Omnidirectional Range) radio stations. VORs are radio stations that transmit an omnidirectional synchronization signal followed by a circular sweeping directional signal. The NAV receiver in the aircraft decodes these signals to determine what angle or "radial" from the station you are on. Radials can be thought of as directional beams radiating outward from the VOR station like spokes of a wheel.

The OBI or VOR Indicator is a panel-mounted instrument that lets you determine what VOR radial your plane is currently on. It also helps you fly along radials toward or away from the VOR station.

Two OBIs are provided. The top OBI (Reference Figure 1, item 8) corresponds to the NAV1 radio. The bottom OBI (item 9) corresponds to the NAV2 radio.

To navigate to and from VORs:

To set the OBI, press the VOR key (*V*). Next, if you want to adjust an OBI other than the one you most recently adjusted, press number *1* for the top OBI, or *2* for the bottom OBI. Then, press the + or − key as needed to select the right course and reciprocal course readings. Each keypress adjusts the course selector by two degrees. Holding the + key down rapidly sequences through the degree settings. The letter "V" on the knob of the OBI indicator refers to the V key.

Communications Radio

Use the COM radio to tune into ATIS for weather, airport, and approach information. The charts at the back of this manual note the ATIS frequencies for each airport where this service is available. The same procedure that is used to set NAV radio frequencies is used to set the COM radio, except that you press the COM key (*C*) instead of the *N* key.

Transponder

On occasion, Air Traffic Control (ATC) will ask you to transmit a four-digit code or "squawk." The message from ATC will scroll across the top of your screen. ATC will use the number your transponder transmits to track you on its radar screen.

To help ATC track you:

To set the transponder, choose the digit you want to change. To change the left-most digit, press the Transponder key (*T*), then press the + or − key on the main keyboard as necessary to select the appropriate digit. To set the second digit, press *T T*, in rapid succession, followed by the appropriate + or − keypress. Press *T T T* and *T T T T* to set the third or fourth digits, respectively.

Altimeter

To set the altimeter to the current barometric pressure, press the Altimeter key (*A*). The altitude reading may change when you press this key. We recommend that you do this several times each hour in reality mode to ensure accurate altimeter readings.

The letter "A" on the altimeter's adjustment knob refers to the A key.

Heading Indicator (Directional Gyro)

Pressing the Directional Gyro key (*D*) sets the heading indicator to the same reading as the magnetic compass. (The magnetic compass does not drift with time as the heading indicator does, and it will always show a correct reading when "settled down" after a turn.) Always be sure the magnetic compass has settled down to avoid setting an incorrect direction. The letter "D" on the heading indicator's adjustment knob refers to the D key.

Landing Gear

The Landing Gear key (G) raises and lowers the *landing gear.* The gear indicator on the panel shows the current status of the landing gear. You do not have to raise the landing gear after takeoff. If you do raise it, however, be sure to lower it on landing approach. Flying with the landing gear down increases drag.

Brakes

The Brakes key (.) applies the brakes. Each keypress reduces your speed by a few knots. Several presses are usually necessary to bring the plane to a complete stop. Brakes are used only on the ground.

Keyboard Techniques

Keypresses

Holding down most alphanumeric keys automatically generates many keypresses (at the rate of 12 per second). Holding down the elevator, aileron, rudder, or throttle control keys results in multiple notch adjustments. For example, alternately holding down the left and right aileron keys will gently rock the plane from side to side (when doing "Dutch Rolls," for instance). The . key (the brakes), if held down, will eventually bring a taxiing plane to a stop.

However, toggle keys, such as the G key (which raises and lowers the landing gear), should not be held down. Doing so will repeatedly switch between the two settings.

The PC and PC XT keyboards can accept keypresses at any rate and in any sequence. In fact, two keys can be pressed simultaneously. This feature is particularly useful in uncoordinated flight mode, when you must adjust the aileron and rudder together to ensure smooth turns (more about uncoordinated flight later). However, you cannot hold down two keys at one time and also generate the multiple repeated effects explained above.

Finger Positioning

Finger positioning for operating the controls located in the control diamond is not the same as that used on an alphanumeric keypad. You will find it easy to operate these controls if you follow the "ten-key-by-touch" system, used by many people to operate adding machines and calculators.

Place the middle finger of your right hand on the 5 key on the numeric keypad (at the right of the main alphanumeric keyboard). Then place your index and ring fingers on the 4 and 6 keys. To control the rudder pedals, use your thumb and little finger to operate the 0 and + keys.

Using Joysticks

You can control Flight Simulator ailerons, elevators, and throttle through the keyboard or through joysticks. To use joysticks, you will need an IBM Game Control Adapter Card (or an equivalent card) and one or two joysticks with buttons. The Game Adapter Card supports two joysticks designated as Joystick A and Joystick B. With Flight Simulator, Joystick A is used to control ailerons and elevators, and Joystick B is used to control the throttle.

The IBM Game Control Adapter can handle two joysticks simultaneously. Since there is only one socket on the adapter, both joysticks must fit into a single connector. However, since joysticks are seldom sold in pairs, most use a connector designed for a single joystick only.

The documentation supplied with your Game Adapter specifies how to support two joysticks. You can build, or have your computer store build, a Y-adapter. This splits the single connector into Joystick A and Joystick B sockets, allowing you to plug both joysticks simultaneously.

Note Check with your dealer or the manufacturer of your joystick to see if an adapter has already been made for this purpose.

Setting up the Joysticks

Joysticks are either self-centering (the stick returns to the center position when released) or non-centering. Ailerons can be controlled with either a non-centering or self-centering joystick, as you prefer.

Note Only non-centering joysticks can be used to control the elevators and the throttle.

The IBM joysticks used with the PCjr have mechanical switching levers to enable or disable the self-centering springs. These switches are usually on the underside of the joystick case. The ideal setup for Flight Simulator joystick control is:

Ailerons (Joystick A, X-movement) = self-centering

Elevators (Joystick A, Y-movement) = non-centering

Throttle (Joystick B, Y-movement) = non-centering

Warning You may be able to disable the self-centering mechanism on joysticks that do not have switching levers. However, check with your joystick manufacturer before attempting any alteration.

Installing and Turning on the Joysticks

To install joysticks:

- Turn the computer off, and install the Game Control Adapter Card and joysticks(s) according to the instructions that accompanied these products.
- Turn the computer on, and load Flight Simulator according to the instructions for "How to Load Flight Simulator."
- Enter the editor by pressing Esc, and press Enter to move to the Joystick parameter on the second edit page. (For details, see chapter entitled "The Editor.")
- For the Joystick parameter, enter a *1* to turn on just Joystick A, or enter a *2* to turn on both joysticks (A and B).
- Return to flight mode by pressing Esc.

Joystick A can now be used to control the ailerons and the elevators (and the rudder in auto-coordinated mode). Sideways movement (on the X axis) controls ailerons and roll, and forward and backward movement (on the Y axis) controls elevators and nose up and down. (See Figure 20.) Slowly move the stick through its complete X and Y range, watching the elevator and aileron (and auto-coordinated rudder) indicators move. The movement may be jumpy, and pushing the stick in a specific direction may not move the ailerons or elevators in that direction, but calibration will solve these problems.

If you have two joysticks and entered *2* as the Joystick parameter, Joystick B can be used to control the throttle. Full forward provides full throttle, and full back reduces engine to an idle.

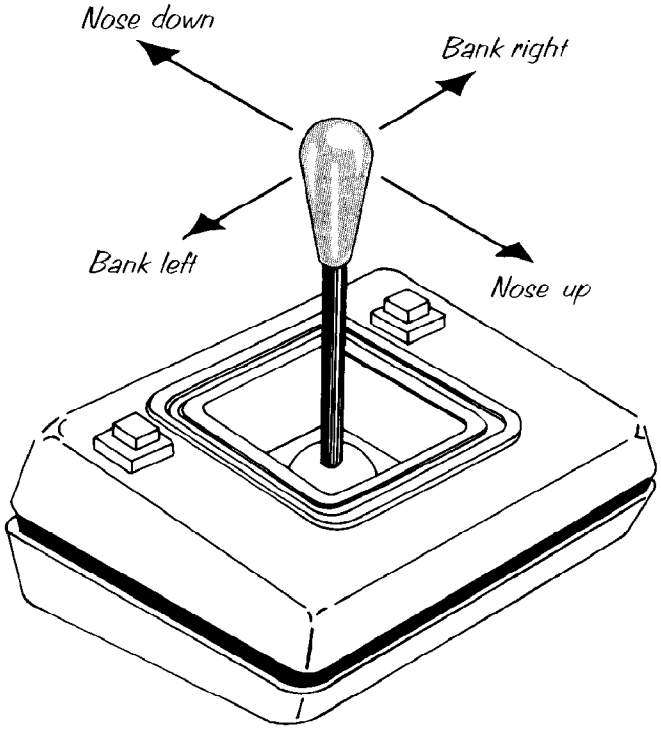


Figure 20. Joystick for the PC

Calibrating the Joysticks

After setting the Joystick parameter, you must calibrate the joysticks. Joysticks vary greatly from manufacturer to manufacturer. The range of numerical values generated also varies widely. The IBM Game Control Adapter specification calls for joysticks with 0 to 100K ohm resistance and linear response. Joysticks with these characteristics work best with Flight Simulator.

The following calibration procedure will compensate for joystick tolerance and for joysticks that deviate from IBM's specification.

Important Do not enter the editor or press the Pause key during this process.

To calibrate the aileron and elevator joystick:

If you're using one joystick:

- Move Joystick A to its aileron and elevator center positions.
- Center the joystick's trim controls (if any).
- Press the *K* key.

To calibrate the throttle joystick, as well as the aileron and elevator joystick:

If you're using two joysticks:

- Move Joystick A to its aileron and elevator center positions.
- Center Joystick A's trim controls (if any).
- Make sure that Joystick B's trim controls (if any) are centered.
- Pull Joystick B all the way back.
- Press the *K* key.

When Joystick A's range is properly calibrated, the aileron indicator is set full left when the stick is fully left and full right when the stick is at its full right position. The elevator indicator is set full down when Joystick A is fully forward, and it is full up when the stick is fully back. Likewise, when Joystick A is in its center position, the ailerons and elevators are centered.

Make sure Joystick B is pulled all the way back. If it isn't, the plane will start accelerating.

During flight, you can use any trim controls on the joysticks to make minor adjustments and to keep the controls centered if the calibration drifts.

Using the Microsoft Mouse

You can use Microsoft Mouse with Flight Simulator. The mouse controls an on-screen pointer (icon) that resembles a hand and can be used to point at radio controls and instrument knobs.

Mouse Setup

To use the mouse, you must first boot the MS™-DOS system disk. After installing the mouse driver, you then boot Flight Simulator from MS-DOS, instead of as a stand-alone disk.

To set up Flight Simulator for using the mouse, follow the instructions listed below. You must have at least 128K of memory to use the mouse.

Always use drive A to install the mouse driver and boot Flight Simulator:

To install the mouse:

- Boot the MS-DOS disk.
- Remove the MS-DOS disk and insert the mouse disk with the MS-Mouse driver on it. (This is the disk that you received with your Microsoft Mouse. It should have the MOUSE.COM file on it).
- Type *mouse* and press Enter.

  Computer will respond with:

  ```
  Mouse driver installed
  ```

  If you get an error message that says:

  ```
  Bad command or file name
  ```

  you should check your mouse disk to make sure that the "MOUSE.COM" file is on there.
- Now that the mouse driver is installed, remove the mouse disk and place the Flight Simulator disk in drive A.
- Type *FS*, and press Enter.

After the Flight Simulator disk boots up and after the initial monitor color and flight mode questions, you will be asked if you want to use the mouse. If you respond with *Y*, the "hand" pointer will appear on the screen. If the mouse driver was not installed in DOS, you will get a message saying that no driver was found. You can continue without mouse control, or reboot your DOS disk and install the driver following the above procedure. (If you are familiar with DOS batch files, you may wish to set up a DOS batch file to run the mouse INSTALL program and Flight Simulator.)

To control instruments and indicators:

Microsoft Mouse can be used to adjust all instruments and indicators on your panel except elevators, rudder, flaps, and ailerons. You may want to set up Flight Simulator to use your joysticks for the control yoke and the mouse to control all other functions.

To control Flight Simulator with the mouse, move the pointer to the instrument or indicator you wish to change. Press the left button to decrease the current reading and the right button to increase it. For example, to change the NAV radio frequency to a lower number, point the hand at the digit you wish to change and press the left button. This same process applies to the transponder, COM radio, and clock. You can also reset the seconds to transform your clock into a stopwatch.

The VOR omni-bearing selector can be adjusted by positioning the hand on the "knob" (not the digits) on the VOR indicator and pressing the right or left button to increase or decrease heading. The altimeter and heading indicator can be set similarly by pointing at their "knobs" and pressing either button.

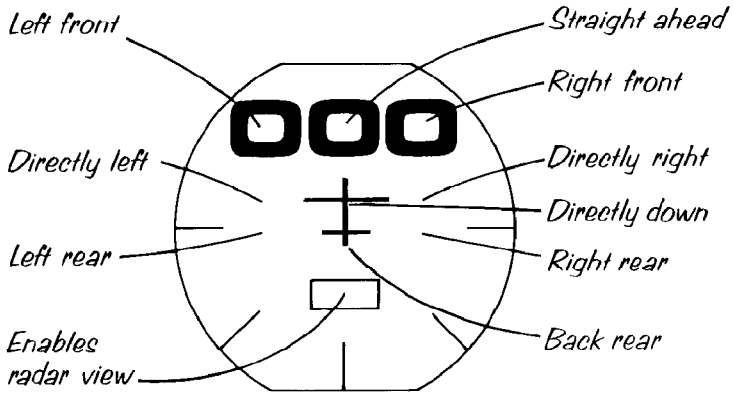
The mouse can also be used to toggle switches on or off. For example, to turn on the carb heat, point the hand at the CH indicator, and press either button. Pressing a button again will turn it off. For magnetos, the hand will cycle through the options once for every button press.

To adjust the throttle, position the mouse hand along the throttle indicator. Left decreases; right increases. The same applies for the trim. The mouse does not activate the flaps, ailerons, elevators, or rudder. To apply the brakes, position the hand along the rudder indicator and press either button.

To change the view:

The mouse can also be used to change the view selector. To change the view, position the mouse inside the heading indicator (directional gyro) dial. (See Figure 21.) To activate the front three views – straight ahead, right front, and left front – point the mouse to the corresponding digit in the top of the readout. To look directly left or right, point the mouse to the edge of the left and right wingtips on the plane outline. To look down, point the mouse to the middle of the outline. To activate the three rear views, point the mouse on the rear of the outline of the plane, as shown.

To activate the radar view, point the mouse to the small rectangular area located directly below the outline of the plane. Pressing either button activates the radar. To zoom in, press the right button. To zoom out, press the left button. The mouse must be pointing to the small rectangle while zooming in and out. To return to the out-the-window view, simply point the mouse to any view select area, as outlined above.



Heading Indicator (Directional Gyro)

Using Flight Simulator

This chapter covers everything you need to know to actually taxi down the runway, take off, fly, land, and service your plane. Once you know how to fly, you'll be ready to add more challenge to your flights.

Then learn how to use the Flight Simulator editor. Choose from 10 preset user modes. Or use the editor to change environmental conditions and other parameters to create your own flight modes. At any time, you can have up to 30 flight modes.

Practice your navigation throughout the world. Flight Simulator lets you travel more than 100 million square miles. Charts at the back of the manual detail 21 airports in four general areas on the East Coast, the Midwest, and the West Coast. Using navigational aids, you can fly by day or night.

After you're comfortable with easy, auto-coordinated flight, move on to advanced flight techniques. Choose uncoordinated flight where you control the ailerons and rudders independently of each other. With Flight Simulator and a flight training manual, you're ready to try maneuvers. Or use Flight Simulator's many instruments, indicators, and controls to try flying according to Instrument Flight Rules.

Flying

Now that you are familiar with the basic flight instruments and controls, prepare for your first flight with Microsoft Flight Simulator.

Note Any time you are flying, you can stop the simulation and return to where you started by pressing the Recall key (Del on the PCjr, or the PrtSc key on the PC).

If you only want to suspend the simulation, press the Pause key. Simulation will continue when you press the Pause key a second time.

If you want to return to DOS, insert the DOS disk in drive A, and press Ctrl, Alt, Del in sequence, holding each key down until all three keys are pressed.

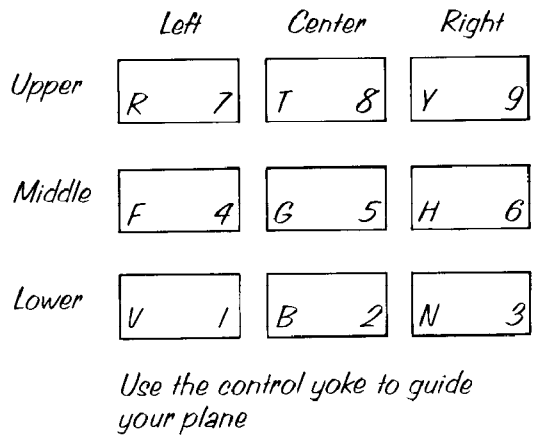


Figure 22. Control Yoke Diagram

In the control yoke, letters refer to the PCjr keyboard; numbers refer to the numeric keypad on the PC. This manual refers to yoke keys by relative position. For example, on the PCjr, the Y, F, and B keys are the upper right, middle left, and lower center keys. Both G and 5 are simply called the center key.

Flying under VFR Conditions

When you start the program, you are facing north on the runway at Meigs Field (a small field on a peninsula on Lake Michigan) in Chicago (see Chart 2). The John Hancock building is on the horizon to your left (northwest). You will take off and climb out over Lake Michigan.

Take off:

You are lined up for immediate takeoff. The weather is fair. The sky is blue and the ground light green, indicating a clear day without a cloud in the sky. There are no winds. This is perfect weather for Visual Flight Rule (VFR) flying.

When you fly VFR, you rely on ground references and the visible horizon for orientation and navigation. Until you get off the ground, navigation is secondary to flight control. The most important instruments for your first VFR flight are the *airspeed indicator* and the *altimeter*. You will use the other primary flight instruments, as well as the aileron, rudder, elevator, and throttle position indicators. For your first flight, concentrate on what you see out the window and how it relates to altitude, airspeed, bank, and pitch attitude.

Getting Familiar with the Aircraft

Take a moment to study the three-dimensional display on your screen. This is the view out the aircraft's windshield.

Use the view selector to look to the right. Press the View key and the upper right key on the control yoke. Try other views, then return to the front view by pressing the View key and then the upper center key.

Check your instruments:

Check your altitude. Altitude is measured by the altimeter. Remember that altitude is measured as feet above sea level. Although you have not yet left the ground, the altimeter shows an altitude of 592 feet, the elevation of Meigs Field.

Now check the compass. It tells you that you are facing 0 degrees. A 270-degree reading corresponds to the aircraft pointing west. Notice the heading indicator. It notes your direction as 0 degrees. The compass and heading indicator provide similar, but seldom identical, readings. Gyroscopic precession and the earth's rotation cause the heading indicator to drift over a short period of time. In reality mode, you must adjust the heading indicator to match the magnetic compass several times each hour by pressing the Directional Gyro key.

Your engine has already been started. (It starts automatically when you start the program.) However, you don't have enough power to move. The airspeed indicator does not register a reading until the aircraft has reached a speed of 40 knots. (Because the airspeed indicator is not registering a reading and the out-the-window view is still, you know your aircraft is standing still.)

It is best to use radar view to taxi around the runway, so take this opportunity to experiment with the radar view feature. Select radar view by pressing the Radar key. To zoom in on a narrower area, repeatedly press the + key on the main keyboard. To broaden your focus, press the − key.

Now, experiment with the ailerons. Turn the yoke full left, then full right, using the middle left and middle right keys. Notice how the adjustments in the ailerons move the aileron position indicator. Try the elevators, paying attention to how the adjustments in elevators move the elevator position indicator. Experiment with the rudder pedals. You must be moving to turn the plane, so for now just see how moving the rudder moves the rudder position indicator. Notice that the rudder and ailerons move together. In auto-coordinated flight mode, they are locked together. (You are also in auto-coordinated flight mode when you begin the program.) In uncoordinated flight mode, they move separately. Center the rudder by pressing the center key.

Taxiing

You are on the runway positioned for takeoff. While you are on the ground, all objects on the horizon are viewed edge-on. Everything in your field of vision is clustered on the horizon. If you have not already switched to radar view, do so now by pressing the Radar key. Use the + and − keys to "zoom" in or out until you get a good view of your position at the airport.

Apply the throttle:

Begin to *taxi* by applying the throttle. For now, one notch is sufficient, so press the Increase Throttle key once.

Use the rudder pedals to steer the plane. Turn the rudder left and right (by pressing the left rudder and right rudder keys) to steer the airplane down the runway. Try to stay on the center line. Press the center key to quickly center the rudder and nose-wheel, so you can taxi in a straight line.

Practice taxiing around the airport. If you need to make an abrupt stop, cut the throttle and apply your brakes by pressing the Brakes key repeatedly. If you want to roll to a gentle stop, simply cut the throttle by pressing the Throttle Cut key (/ and [on the PCjr, F10 on the PC).

If You Crash

If you crash, your three-dimensional display will temporarily go blank. If you have crashed into an obstacle, the word *CRASH* will appear on your screen. You will also get this message if you crash to the ground while flying. If you have landed in water, the word *SPLASH* will tell you so. In either case, the program will then return to the preset starting position (the same location you are moved to when you begin the simulation or press the Recall key).

Pre-Takeoff Check

Now that you know how to taxi, prepare for takeoff. Taxi to either end of the runway (*active runways* have a number on either end). Align your plane with the center line. Cut the throttle and coast to a stop. If necessary, apply your brakes by pressing the Brakes key repeatedly.

Now conduct your pre-takeoff check.

To see if all systems are go:

- Check elevator operation. Move the elevators up and down and then center them.
- Check the rudder and ailerons in the same way. Center them.
- Check the engine gauges. Make sure the oil pressure is correct. The indicator should be centered between L(ow) and H(igh). Also make sure you have plenty of fuel (check both gauges).
- Finally, check the heading indicator against the magnetic compass. If they do not agree, set the heading indicator to match the magnetic compass by pressing the Directional Gyro key after the magnetic compass has settled.

If all systems are go, you are ready for takeoff.

Takeoff

Before you take off, you may want to read the sections on climbing, turns, straight and level flight, and glides and descents. If you would rather not, don't worry. This is a simulator after all. You can stop the simulation at any time by pressing the Pause key. Press it again to continue.

Switch from radar to three-dimensional view by pressing the View key. Switch to the forward view by pressing the View key, followed by the upper center key. Notice that pressing the View key once switched the display from radar view to three-dimensional view. To select a three-dimensional view direction, you must press the View key a second time, immediately followed by a heading indicator key.

Accelerate down the runway:

Apply full throttle (by pressing the / and] keys on the PCjr, or the F2 key on the PC). As you move down the runway, steer with the rudder, adjusting it to keep a steady course and to avoid zig-zagging. (Remember, pressing the center key will center the rudder.)

Notice that the airspeed indicator shows the rise in speed. When you reach 55 knots, raise the nose by pressing the lower center key rapidly six times. Pulling back the yoke and raising the nose off the ground is called the rotation. The runway drops away as you lift off. As your nose pitches up, the vertical speed indicator will register a positive reading.

You are airborne. Reduce the throttle one notch, and prepare for a gentle climb. Look out the back window by pressing the View key and the lower center key. Return to front view by pressing View and the upper center key.

Climbing

Flight Simulator, like a real aircraft, climbs by itself and does not require constant adjustments. If you took off as directed, you should be steadily climbing. To increase your rate of climb, increase the throttle. Raise the elevators enough to hold a constant airspeed. Raising the elevators converts airspeed into vertical velocity.

Adjust the throttle:

Do not attempt to increase or decrease climb rate by simply raising or lowering the elevators without adjusting the throttle to maintain constant airspeed. Raising the elevators without increasing the throttle will increase your climb rate for a few seconds, but you will soon lose momentum and your airspeed will drop. This may cause the plane to stall. On the other hand, increasing the throttle without applying the up elevator will increase your speed, but not necessarily your rate of climb. Understanding the relationship between the elevators and throttle adjustments is basic to successful flight. The relationship between speed, vertical velocity, elevators, and throttle is complex. You will come to understand it only through practice.

Straight and Level Flight

Once you have reached an altitude of about 3,000 feet, settle into straight and level flight. Gradually make the transition from climbing to straight and level flight. Lower the elevators and decrease the throttle to attain a reasonable speed (about 120 knots) without gaining or losing altitude. Remember not to chase the vertical speed indicator. Instead, use the altimeter and airspeed indicator as guides, making small adjustments in the throttle and elevators as necessary. Once you have settled into a straight and level flight pattern, your vertical speed reading will drop close to zero.

Check the altimeter periodically to make sure you are not losing altitude. If you are losing altitude, increase the throttle or raise the elevators.

Turns

Turns are made by banking and yawing the plane in the direction you want to turn. The ailerons are used to bank the plane, and the rudder is used to yaw it (from left to right). In auto-coordinated flight mode, the ailerons and rudder are connected, so you need to use only the ailerons to control your bank.

Use the ailerons and rudder:

Move the aileron one notch to the left. You will begin to bank left. (Notice how your bank attitude is shown on the attitude indicator.) When the bank approaches the 20-degree mark, center the aileron/rudder. Check the attitude indicator and turn coordinator again. You are turning.

You will continue turning at the specified angle until you "roll out" of the turn. Flight Simulator is positively stable and makes provisions for wing *dihedral* effects, so if you don't manually perform a roll out, the plane will eventually straighten itself after a few minutes of flight.

To roll out of a turn, apply the opposite aileron until your attitude indicator shows that you have centered on your course. Timing is the most important factor in rolling out of a turn. As a general rule, apply the opposite aileron/rudder when your heading indicators show a reading 10 degrees short of your desired *heading*. For example, if you want to proceed on a heading of 180 degrees, begin rolling out of the turn when the compass indicates a 170-degree heading. It takes time to level your position. You are still in a bank while rolling out of a turn, so you will continue to turn even while you level off.

Always check the altimeter when you have completed a turn. Turns cause you to lose altitude: the steeper the bank, the greater the loss. To compensate, raise the elevator a notch or so as you are turning.

Glides and Descents

Glides reduce altitude with little or no engine power. Proper glide technique is essential to landing approach.

To climb, you increased the throttle and raised the elevators to increase altitude. It seems logical that to descend you would do the opposite; that is, lower the elevators and decrease the throttle. This is not proper glide procedure, however. When you decrease the throttle, the plane drops its nose. Airspeed increases if you decrease the throttle and either keep the elevators where they are or lower them.

To descend, decrease the throttle, then apply a bit of up elevator to hold constant airspeed and to keep the nose from dropping. Judging how much elevator to use takes experience. Watch the world outside when you decrease the throttle. Also study your pitch attitudes as you glide.

Now, practice gliding. Climb to 5,000 feet, level your position, and cut the throttle. You will descend at a rapid speed. If your airspeed gets dangerously high (exceeding 140 knots), raise the elevators one notch. This will raise your nose and help level your dive.

You can also increase the angle of a glide and reduce airspeed by using the flaps. This is particularly useful if you are too high on an approach to landing. Flaps also decrease stall speed during approach and landing.

Practice glides and descents.

Landing

Correct and safe landing is the most challenging part of flying. In essence, to land you will fly a foot or two above the runway, then slow down until the plane stalls and stops flying.

Descend until you can see the runway. Every active runway has a number on either end. The line down the center of the runway is your guide for touchdown.

Your approach glide should be steep:

When you have spotted the runway, align yourself with it and fly toward it at approximately 70 knots. Your approach glide should be a steep one. The throttle should be cut and the elevators raised to maintain a 70-knot approach. An engine failure during a steep glide will have little effect on where you land. However, an engine failure during a long, shallow, *power glide* could make you land short of the runway.

You must make a transition to straight and level flight when you are approximately 50 feet above the runway, so you will be in straight and level flight a foot or two above the runway. This procedure is called the *flare.*

If you didn't raise your landing gear after takeoff, it is already lowered. Otherwise, lower it by pressing the Landing Gear key.

Your airspeed will start to drop as the plane loses momentum. As the plane slows, the nose will drop. Raise the elevators to keep the plane a foot or two above the ground. As you do so, the nose will rise.

Make sure your rudder is straight before you touch down. The rudder pedals, as well as the rudder, control ground steering. You will be whipped off the runway if your wheels are not straight as you touch down. An abrupt turn of the plane on the ground (a ground loop) can severely damage a real aircraft. On touchdown, your elevators will be nearly all the way up.

Slow down until you stall:

When your speed is reduced enough so that the plane can no longer fly, it will stall and touch down on the runway. If you "fly the plane onto the ground" above stall speed, it may bounce.

As you touch down, you will hear a sound and see the scenery on the display level off. Use the Brakes key to *bleed off* speed, guiding the plane with the rudder. Continue to apply the brakes until you come to a complete stop.

You have successfully completed your first flight. To practice the fundamentals of flying before attempting advanced flight techniques, taxi to the end of the runway and prepare for takeoff. Don't forget to perform the pre-takeoff check as discussed earlier in this chapter.

Refueling and Servicing

All of the airports (except for the small, single-runway grass strips) have fuel and servicing facilities. These areas are marked by rectangles and are located at the ramp areas. (Each rectangle has an "F" inside it.) To refuel and have your aircraft serviced, come to a complete stop inside one of these rectangles. Both refueling and repairs occur instantaneously.

The Editor

You can add several environmental factors to flight modes to enhance visual effects and produce realistic flight environments. To set these factors, you use the editor. You also use the editor to adjust flight variables and peripheral options.

To change your flying environment:

To enter the editor, press the Esc key. A menu of parameters will appear on the screen. The first column lists parameters. The second column lists the current values of the parameters.

Entering the editor suspends simulation. The North, East, and Altitude parameters always note the values of your last position before you entered the editor.

The arrow that points at the parameter list is used to select the parameter you want to change. To move the arrow from one parameter to the next, press the Enter key. To move backward through the list, press the − key (located on the top row of the main keyboard). When the arrow points to the parameter you want to change, enter the new value. If you make a mistake, press the Backspace key to erase each incorrect character, then enter the correct number. When you have entered the new parameter, press the Enter key.

Exit the editor by pressing Esc:

When you have changed all the parameters you want to change, exit the editor by pressing Esc. You will return to flight mode unless you select slew mode.

Microsoft Flight Simulator supports 30 flight modes (combinations of parameters). Two flight modes are in effect when you begin the Flight Simulator program: easy mode and auto-coordinated mode. To select other modes, you use the editor. See "Selecting and Customizing Flight Modes" later in this manual.

Note You cannot change the parameters of the WWI Ace game.

Environmental Factors

Microsoft Flight Simulator simulates various environmental conditions that affect flying. You can select the time of day or season you want to fly in. You can also specify clouds, wind direction and velocity, and turbulence. Each of these factors increases the realism of the simulation.

Selecting the Season

Each season presents unique flying problems. Winter brings icy runways and startup problems. Summer brings hot, humid days that increase *density altitude* and reduce lift. Each situation requires different skills.

To select the season you want to fly in, enter the editor and move the arrow to the Seasons parameter. Select the season by typing one of the following numbers:

Code	*Season*
1	Winter
2	Spring
3	Summer
4	Fall

Return to flight mode by pressing the Esc key.

Selecting the Time of Day

Flight Simulator automatically sets the visual flight conditions to correspond to the time of day (as it appears on the clock). The clock records time in 24-hour format.

The transition from one flight condition to another varies from season to season, as follows:

Season	*Dawn*	*Day*	*Dusk*	*Night*
Winter	7:00	7:30	17:00	17:30
Spring	6:00	6:30	19:00	19:30
Summer	5:00	5:30	21:00	21:30
Fall	6:00	6:30	19:00	19:30

The transition times are identical for all parts of the world.

Flight Simulator simulates typical visual conditions for these four times of day: dawn, day, dusk, and night. Since the visual conditions for dawn and dusk are identical (though reversed), choosing either presents the same flight conditions.

If you want to select a visual flight condition that differs from the one set based on the clock setting, use the editor to change the time displayed on the clock. Enter the editor by pressing Esc, then move the arrow to the Hours parameter.

Enter the hour in 24-hour format; for example, 09 for 9 A.M., 23 for 11 P.M. Then move to the Minutes parameter and enter the appropriate number. The range is 0 to 59. Return to flight mode by pressing Esc.

Setting Clouds

You can set either one or two cloud layers. Cloud layers are measured above sea level. To simulate a cloud layer, enter the editor by pressing Esc and move to the Cloud Layer 1 Bottoms parameter.

Set the altitude of the lower edge of the cloud, then enter the altitude (above sea level) where you want it to end next to the Cloud Layer 1 Tops parameter. If you set a second cloud layer using the Cloud Layer 2 Bottoms and Tops parameters, make sure the upper layer begins higher than the top of the lower layer. Return to flight mode by pressing Esc.

To eliminate a cloud layer, set the Cloud Layer Bottoms and Tops parameter altitudes to zero.

Setting Surface Wind

You can set wind to simulate realistic takeoff conditions by setting surface wind velocity and direction, as well as shear altitude. Shear altitude is the altitude where the wind layer ends. Unlike cloud layers, winds are set from ground level, not sea level. Thus, if you set a shear altitude of 1,000 feet, you will encounter surface wind from ground level to 1,000 feet.

To set the surface wind velocity, direction, and shear altitude, enter the editor and move the arrow to the Surface Wind parameters. Enter the speed in knots (range 0 to 99), the direction in degrees (0 to 359), and the shear altitude (Shear Zone Altitude 1 parameter) in feet (above ground level).

Setting Winds Aloft

Flight Simulator can also simulate wind layers above the surface wind level. As with surface winds, you determine wind velocity, direction, and shear altitude. Shear altitudes determine where one level ends and the next begins. Shear altitude is measured above ground level, not sea level.

Set up to three wind layers:

To set winds aloft, enter the editor and move to the Wind Level 1 parameter. Enter velocity (speed is limited to 99 knots), and direction (from 0 to 359 degrees). This wind layer will exist between Shear Zone Altitude 1 and Shear Zone Altitude 2. Adjust Shear Zone Altitude 2 to the uppermost altitude of Wind Level 1.

You can set a maximum of three layers of winds aloft. Wind layers must not overlap.

Setting Turbulence

Turbulence factors ranging from 1 (very low) to 9 (very high) can be added to both winds aloft and surface wind settings.

To set turbulence, multiply the turbulence factor by 100 and add it to the wind speed. For example, to set a wind speed of 37 knots and a turbulence factor of 4, multiply 4 by 100 and add 37. This sets the wind speed for the specified wind level to 437.

The World and Navigation

The Flight Simulator world spans more than 100 million square miles, encompassing the continental United States and extending into Canada, Mexico, and the Caribbean. The center coordinate (x = 0, y = 0) of the Flight Simulator world is 40 degrees north latitude and 88 degrees 30 minutes west/east longitude, about 30 miles southwest of Champaign, Illinois.

The world database includes approximately 80 airports in four general areas: New York/Boston, Central and Northern Illinois, Seattle, and Los Angeles. Charts 1 through 4, at the back of this manual, are aerial charts of these areas. These charts, although highly accurate, are for use with Flight Simulator only.

You can fly beyond the database areas, into Canada, for example. However, only the four areas mapped in the charts at the back of this manual are populated with airports and other ground reference points.

Getting Around in the World

Because Flight Simulator is a real-time simulator, flying between distant points (such as Seattle and Los Angeles) would take hours. Your fuel tank holds 88 gallons of gas, enough to take you, under most conditions, approximately 1500 miles from your point of origin. There are no refueling stations outside the populated world, so the distance you can fly is limited.

However, you can move from one distant area to another by using one of two methods: setting destination coordinates or "slewing."

Changing coordinates in the editor:

The faster way to move from one area to another is to set the destination coordinates. Enter the editor, move the arrow to the North parameter, and enter the north coordinate of your destination (refer to Charts 1 through 4 for each airport's precise destination coordinates). Now move the arrow to the East parameter. Enter the east coordinate of your destination. Finally, move the arrow to the Altitude parameter and enter the altitude at which you want to fly.

Exit the editor by pressing Esc. You will be at your destination at your selected altitude. Continue flying or taxiing as you would in regular flight mode.

"Slewing":

The second method of moving from one flight area to another is slewing. Slewing lets you move very slowly or very rapidly (faster than you could fly) from one point to another, viewing the scenery along the way.

To enter slew mode, enter the editor and set the Slew parameter to 1, or 2, then press Esc. Your previous north and east coordinates (your position before you entered the editor) will be displayed at the top of your screen. You will see the scenery out the windshield as if you were in flight mode.

When you are slewing, you use slewing controls instead of normal flight controls to move about. Figures 23 and 24 illustrate the slewing controls for the PCjr and the PC. Slewing speed and direction are set by pressing one of the four directional keys on the control yoke. Slew parameter 1 moves the plane strictly north, south, east or west. Slew parameter 2 moves the plane relative to your current heading. Pressing the upper center key slews the plane straight north (Slew parameter=1) or straight ahead (Slew parameter=2). Pressing a key once slews you very slowly. Pressing a key twice increases slew speed. Multiple keypresses increase slew rate exponentially. Pressing the lower center key slews the plane due south or backwards. These two keys control north coordinate changes when Slew parameter=1. The middle left key slews the plane west or left, and the middle right key slews it east or right. These two keys control east coordinate changes when Slew parameter=1. Note how these four keys are positioned to suggest their relationship to the direction in which they move you.

The north and east coordinates displayed at the top of the screen are also listed next to the North and East parameters in the editor. As you slew around the world, the values next to the North and East parameters change to reflect your new position.

Pressing the middle center key stops slewing and freezes the plane in its current position. To continue slewing, you must press one of the North or East keys again. If you are slewing too quickly in one direction (north, for example), you can decrease your slew rate by pressing the key for the opposite direction one or more times (in this case, the lower center, or South key).

The throttle keys control slew altitude:

Figures 23 and 24 indicate the controls that allow you to control your altitude while slewing. The PCjr allows you to only increase or decrease your altitude. Pressing G will stop altitude slewing on the PCjr. The PC allows several different rates of increase and decrease.

Check the altimeter as you slew. Your current altitude is listed next to the Altitude parameter in the editor. As your altitude changes, the number next to the Altitude parameter in the editor changes to reflect your current altitude.

The other keys on the control yoke operate bank and heading slew. The upper left and upper right keys control bank slew. Pressing the upper left key banks the plane left. Pressing the upper right key banks the plane right. The lower left left and lower right keys control heading slew. Pressing the lower left key rotates the plane to the left. Pressing the lower right key rotates the plane to the right.

On the PCjr, the (and) keys control pitch slew. Pressing G will stop pitch slewing. On the PC, the odd-numbered Function keys control pitch slew, with the F1 key indicating upward pitch, the F9 key indicating downward pitch, and the F5 key level flight. Intermediate keys make subtle adjustments.

Changes in pitch, bank, and heading (unlike changes in north and east coordinates, and altitude) do not correspond directly to the values next to the Pitch, Bank, and Heading parameters in the editor. Changes made in pitch, bank, and heading while slewing are not automatically transferred to the edit page. This lets you adjust your attitude to select a good observation angle while slewing, yet return to your original attitude when you reenter the editor. However, if you want to transfer your slewing attitude to the edit page, press the Transfer key (Shift T on the PCjr, T on the PC).

Pressing the Alt key sets the observation angle (pitch, straight ahead; heading, north; and, bank, 0 degrees). This lets you watch the area you are slewing over as though you were looking straight ahead out of your window.

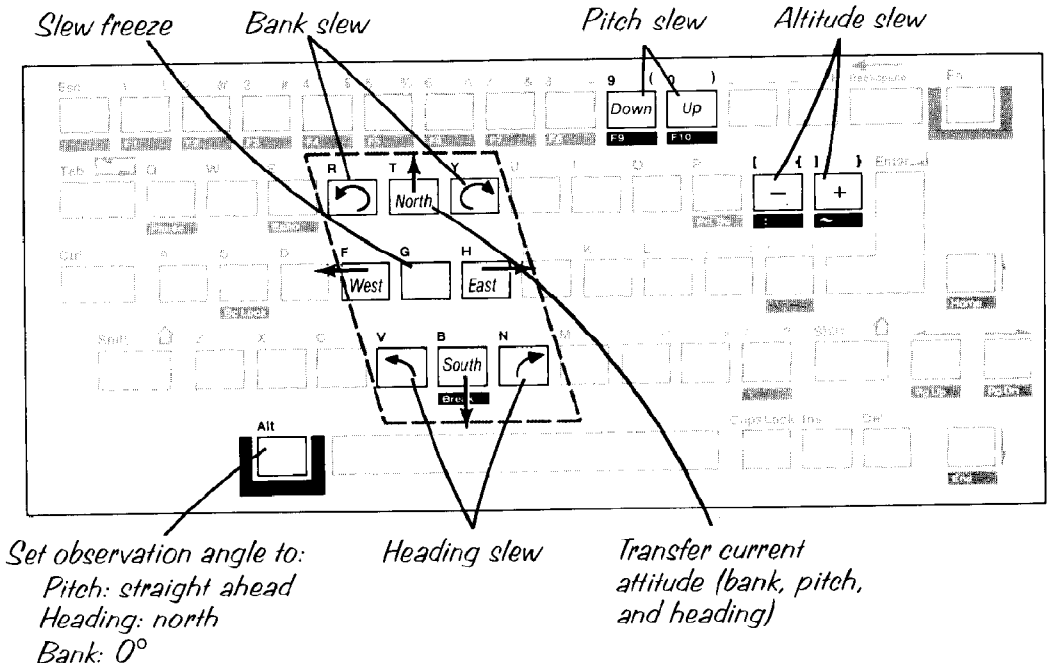


Figure 23. Slewing System Controls for the PCjr

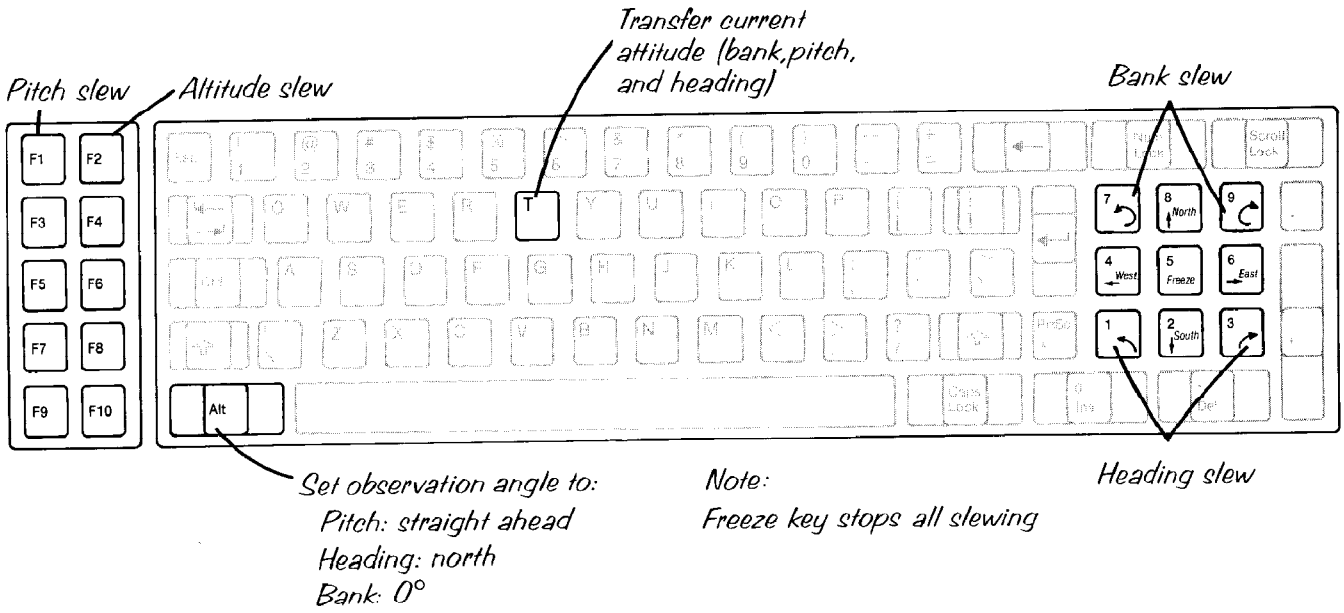


Figure 24. Slewing System Controls for the PC

Navigational Aids

Flight Simulator features two of the most commonly used navigational aids. VOR (Very high frequency Omnidirectional Range) navigation is available for day and night flight. Airport beacons are provided at night. Instrument Landing System (ILS) approaches are also available, and OMI (Outer, Middle, and Inner) marker lights and a glideslope are provided.

VOR Navigation

Use the NAV radios to navigate, day or night:

VORs are radio stations that transmit an omnidirectional synchronization signal followed by a circular sweeping directional signal. The NAV receiver in the aircraft decodes these signals to determine the angle or "radial" from the station you are on. You can think of radials as directional beams radiating outward from the VOR station like spokes of a wheel (see Figure 25).

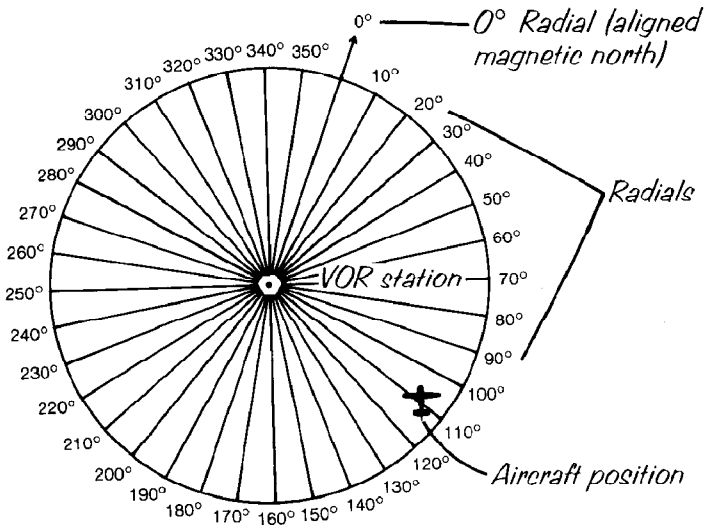


Figure 25. VOR Station and Radials

The Omni-Bearing Indicator (OBI), or VOR indicator, lets you determine what VOR radial your plane is on and helps you fly along radials toward or away from the VOR station.

As shown in Figure 26, the OBI consists of the course deviation indicator (CDI), course selector, course selector knob or omni-bearing selector, and the TO-FROM indicator.

Course deviation indicator: This is a vertical needle that shows your deviation from the VOR radial set by the course selector. If the needle points to the right of center, the radial lies to the right of your current position.

Course selector: This is the numeric value that appears at the top of the OBI. This number indicates the radial your OBI receiver is set to.

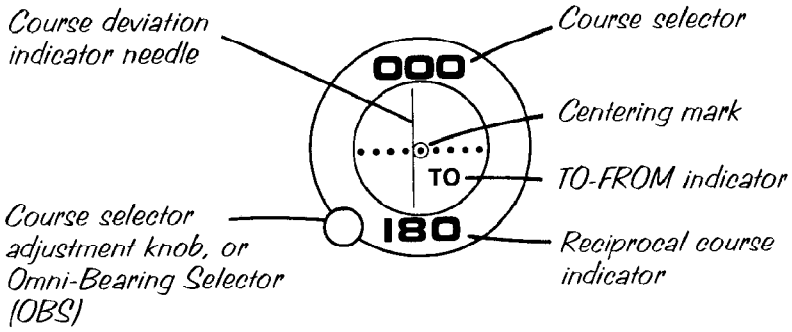


Figure 26. VOR Indicator

Course selector knob or omni-bearing selector: The course selector knob is used to select the radial you want to fly on or to find the radial you are currently intercepting. The course selector value appears on the OBI. The NAV receiver interprets the radial on which the aircraft is currently located, and displays the relationship between this and the selected course on the OBI. The current radial may be "read out" by turning the course selector knob until the CDI needle is centered (and by observing the TO-FROM indicator to resolve any ambiguity).

TO-FROM indicator: This indicator shows whether you are on the radial shown by the course selector or on the radial 180 degrees away from it. When the TO indicator is displayed, the CDI shows course deviation as described above when you are flying toward the VOR station. When the FROM indicator is displayed, the CDI works as outlined above when you are flying away from the VOR station. You can fly toward a VOR station with a FROM indication, or from a VOR with a TO indication, but the CDI will work backwards. If the needle points to the right of center, the radial lies to the left of your current position.

OBI readings: It is important to remember that OBI readings indicate your aircraft's position relative to the VOR station's radial. The aircraft's heading has no effect on the OBI reading. You can, however, use the course selector to estimate the heading you must fly on to remain aligned with the radial.

Since the OBI's reading is independent of the aircraft's heading, you can fly along a selected radial and the OBI indicator will indicate valid course deviations in either flight direction. If the TO-FROM indicator reads FROM, the course selector's course is approximately the heading you should fly. If the TO-FROM indicator says TO, the reciprocal course, as indicated by the digits displayed at the bottom of the OBI, is the approximate heading. On windy days, you will have to compensate for any crosswinds that may blow you off your radial by increasing or decreasing your heading.

The TO-FROM indicator prevents disorientation. You can, if you wish, fly toward a VOR station on the FROM radial, and, as long as the CDI needle is centered, you will stay on course. However, the course deviation noted on the indicator will be backward. If the needle is to the right of center, you will have to fly to the left to intercept the radial again. Avoid this confusion by always flying on the FROM radial away from the station and on the TO radial toward the station.

If you intercept a radial and decide to fly along it, only to find that the needle sense is backward, adjust the course selector to 180 degrees from its current position. This will change the FROM to TO, or vice versa, and will reorient the needle.

To change the course and reciprocal course readings, press the VOR key, followed by either a series of + keypresses to advance the setting or a series of − keypresses to move the setting back. Each keypress adjusts the selector by two degrees. The letter "V" on the knob of the OBI is a reference to the VOR key.

The Uses and Advantages of Two NAV Radios

Two NAV radios and corresponding OBIs are provided to allow you to tune in two VORs simultaneously. There are several advantages to using two NAV radios.

To pinpoint your position:

First, you can identify your exact position by tuning in two VORs and finding the radials on which you lie for both VORs. The point where the two radials intersect (cross) is your position. Figure 27 shows this technique.

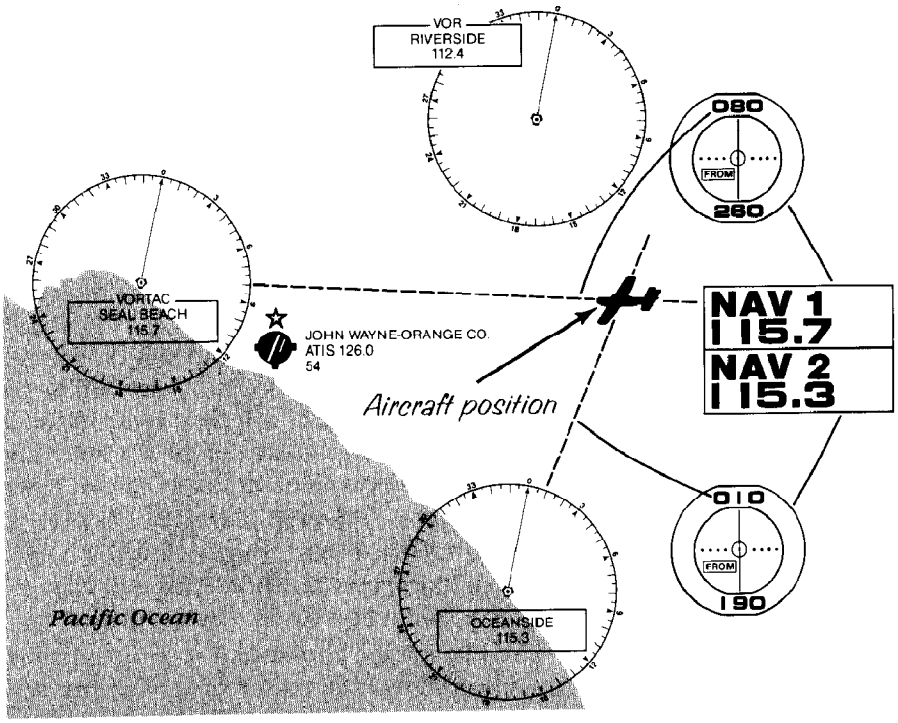


Figure 27. Using Two VORs to Identify Position

When determining your position using radial intercepts, you must be careful that you are on the radial shown by the course selector and not on the one 180 degrees away from it. It is possible to center the needle at two course selector settings; one on the radial you are really on, with FROM showing on the TO-FROM indicator, and the other one on the radial 180 degrees away, with TO showing. Make sure FROM is displayed when you are reading the radial off the course selector, and TO is displayed when reading the radial off the reciprocal course indicator.

To determine flight progress:

Two NAV radios can also be used to determine flight progress while flying toward a VOR. If you are flying toward a VOR tuned in on NAV1, you can set NAV2 to another VOR and set its OBI to a radial you will be crossing on your flight path. When you cross this preselected check point, the VOR needle for NAV2 will swing past center.

With two NAV radios, you can rapidly switch to the other radio (on which you have your VOR frequency and heading already adjusted) when air traffic control tells you to immediately take up a course toward the VOR station.

Finally, a second radio can serve as a backup if the other fails.

Distance Measuring Equipment (DME)

DME registers nautical miles from the VOR you are tuned to. Most VORs in real-world navigation, and all VORs in Flight Simulator, have DME capabilities.

The Flight Simulator DME system is connected to the NAV1 radio. The VOR station tuned on this radio is the one the distance measured corresponds to. Occasionally the DME will be blank when you have a valid VOR tuned in and working. The DME system does not have the range that the VOR's directional navigation signal has. If you are so far away from a VOR that its DME is no longer working, you are too far from the VOR to rely on its directional signal for navigation. In such a case, switch to a new VOR.

Instrument Landing System (ILS) approaches are available at several airports. Consult your airport chart or tune in your COM radio to the ATIS frequency to determine if ILS is available.

OMI lights and glideslope:

The glideslope needle and the Outer, Middle, and Inner (OMI) marker lights are used for ILS approaches. They work in the Flight Simulator program just as they do in real aircraft. Refer to an instrument flying handbook, such as the *Flight Training Handbook*, for information on instrument approach techniques and how to use these instruments.

The Outer, Middle, and Inner marker indicators will also emit tones related to each marker in the form of dots (short tones) or dashes (long tones) in a unique sequence:

Marker	*Tones*
Outer Marker	Repeated sequence of dashes
Middle Marker	Alternating sequence of dots and dashes
Inner Marker	Repeated sequence of dots

Airport Beacons

You can spot airports at night by their flashing beacons. Beacons alternate between green and white. Locations of beacons are shown on the charts at the back of this manual.

Selecting and Customizing Flight Modes

Microsoft Flight Simulator features 30 flight modes. Ten preset modes are contained on your disk. You can create 20 more flight modes by setting parameters or adapting any of the 10 preset modes. To create and select flight modes, you use the editor.

Each of the 30 Flight Simulator flight modes is the unique combination of 37 parameters that control flight and environmental conditions. To review the parameters and their current values, enter the editor by pressing Esc.

Note For PC keyboard users, the number keys (0 to 9) that are pressed to set parameters are those on the main keyboard, not the numeric keypad.

Adjustable Parameters

The adjustable parameters are divided into three categories: simulation control, aircraft position, and environmental control. Aircraft position parameters let you set up test conditions and position yourself in the world.

Simulation Control

User Mode Selects a mode.

Sound Turns sound on and off. Flight Simulator produces normal engine sounds and propeller windmilling sounds (when gliding without power). It also features a stall horn. In the "WWI Ace" game, you will also hear machine-gun fire and the sound of bombs dropping. Press *1* to turn sound on, *0* to turn sound off.

Auto-coordination Links and unlinks ailerons and rudder. Pressing *0* unlinks the rudder and ailerons, allowing them to be controlled separately (as in uncoordinated flight). Pressing *1* links them for coordinated flight. You can fly in either coordinated or uncoordinated modes in easy mode and in reality mode (see below).

Slew Turns the slew system on and off. Pressing *1* or *2* turns the slew system on. Pressing *0* turns it off. (See "Getting Around in the World" information on slewing.) If you have selected slew mode, pressing Esc moves you out of the editor and into slew mode, not flight mode.

Reality Mode Sets the realism factor of the simulator. Pressing *0* simulates easy flight conditions. Pressing *1* simulates a realistic flying environment, which includes the following restrictions:

- The engine must be started using the magneto switch and starter.
- Applying too much throttle too quickly will kill the engine.
- Elevators must be trimmed periodically.
- You must maintain adequate fuel or the engine will stop.
- You can get stuck in mud or a snowbank if you leave the runway.
- The heading indicator will drift from the correct magnetic heading and must be reset by pressing the Directional Gyro key.
- The altimeter will register altitude improperly unless the barometric pressure is periodically reset by pressing the Altimeter key.
- Flying all day with the lights on can burn out a bulb. Burned bulbs are replaced during refueling/servicing stops.
- Carburetor icing will usually occur on warm, humid days. (Ironically, icing is less of a problem on very cold days.)

You can fly in either coordinated or uncoordinated flight in both easy mode and reality mode.

Demonstration Mode Activates a demonstration in which the plane flies itself.

Europe 1917 Sets up the "WWI Ace" aerial battle game. Pressing *1* sets up the game. Pressing *0* sets normal flight simulation. (See "WWI Ace.")

Communication Rate Controls the rate at which the ATIS communication radio messages scroll across the top of the screen. The rate at which information scrolls across the screen ranges from very slow (1) to faster than an air traffic controller talks (255). Values that are powers of two (2, 4, 8, 16, 32, etc.) produce the smoothest scrolling. Others tend to be jerky.

Aircraft Position

North Position Sets the aircraft's north positional coordinate to automatically transfer you from one location to another, or to create test situations (used in conjunction with the East Position parameter). These values are specified in north and east coordinates as cited on the area charts (see Charts 1 through 4). Each unit represents 256 meters. Your current position (your position before you entered the editor) is always displayed here.

East Position Like the North Position parameter, sets the coordinates to automatically transfer from one location to another, or to create test situations (used in conjunction with the North Position parameter). These values are specified in north and east coordinates as cited on the area charts (see Charts 1 through 4). Your current position (your position before you entered the editor) is always displayed here.

Altitude Sets the altitude for transfer destinations (see "Getting Around in the World"). It can also be used to set the altitude for a test situation. This value is specified in feet above sea level. Your current altitude (your position before you entered the editor) is always displayed here.

Pitch Sets pitch attitude for test situations. Must be in the range of 0 to 359 degrees. Your current flight mode pitch attitude is always displayed here.

Bank Sets bank attitude for slew mode or for test situations. Must be in the range of 0 to 359 degrees. Your current flight mode bank attitude is always displayed here.

Heading Sets the heading for slew mode or for test situations. Must be in the range of 0 to 359 degrees. Your current heading is always displayed here.

Airspeed Lets you set airspeed for a test situation. Airspeed is specified in *knots*. (Note: 1 knot = 1.15 mph.)

Throttle Sets the throttle position so you can create test situations. The range is 0 to 32767 (Cut = 0).

Rudder Sets the rudder position so you can create test situations. The range is 0 to 65535 (Center = 32767).

Ailerons Sets the aileron position so you can create test situations. The range is 0 to 65535 (Center = 32767).

Flaps Sets the flaps position so you can create test situations. The range is 0 to 32767 (No flaps = 0).

Elevators Sets the elevator position so you can create test situations. The range is 0 to 65535 (Center = 32767).

Environmental and Peripheral Control

Time	***Sets the clock.***
Hours:	Sets the hour of the day (local time, not Greenwich mean time). Time is set in 24-hour format, so the range for hours is 0 to 23.
Minutes:	Sets the minutes on the clock. The range is 0 to 59.

Season Sets weather conditions that are typical of the specified season. The codes that represent the seasons follow.

Code	***Season***
1	Winter
2	Spring
3	Summer
4	Fall

Cloud Layers Sets lower and upper limits of cloud layers. Specifies beginning (bottoms) and ending (tops) altitudes in feet above sea level. Top limits must be set above lower limits and layers must not overlap. To eliminate clouds, set tops and bottoms to zero.

You can specify two cloud layers as follows:

Cloud Layer 2 Tops
Cloud Layer 2 Bottoms
Cloud Layer 1 Tops
Cloud Layer 1 Bottoms

Wind Sets wind levels. Wind levels can be set at ground level and at three additional elevations. You must set velocity (in knots), direction (in degrees), and shear altitude (in feet above ground level) for each wind level. Shear altitude determines where wind levels begin and end, as follows:

Wind Level 3: Knots
Degrees
Shear Zone Altitude 3
Wind Level 2: Knots
Degrees
Shear Zone Altitude 2
Wind Level 1: Knots
Degrees
Shear Zone Altitude 1
Surface Wind: Knots
Degrees

One level ends where the next level starts.

Reliability Factor Sets the probability factor for problems arising in reality mode. The reliability value is specified as a percentage. A value of 100 ensures a totally reliable aircraft, while a value of 0 presents frequent problems.

Joystick Selects between joystick and keyboard control: "0" assumes keyboard control; "1" selects single joystick operation; and "2" selects dual joysticks. See the section on "Joystick Use and Techniques" for details.

When you enter the editor, the North, East, Altitude, Pitch, Bank, and Heading parameters show the current position of the aircraft. When you leave the editor and return to flight mode, these settings change to reflect your new position as you fly the aircraft.

Preset and User Flight Modes

The flight modes (unique combinations of the above parameters) are numbered 0 through 29. Modes 0 through 9 are preset. They are standard flight modes in which the fundamental parameters are slightly varied. The preset modes follow.

Mode	*Function*	*Location*
0	Easy flight	Chicago, IL
1	Realistic, fair weather flight	Seattle, WA
2	Automated flight demonstration	Chicago, IL
3	Dusk flight	Los Angeles, CA
4	Night flight	Chicago, IL
5	Moderate weather flight	New York, NY
6	Bad weather flight	Boston, MA
7	WWI Ace battleground	Europe
8	Airborne startup situation (normal)	San Diego, CA
9	Airborne startup situation (emergency)	Champaign, IL

Mode 0 is the mode you are in when you start the program. Mode 2 is a flight demonstration. Mode 1 and modes 3 through 6 simulate special flying conditions. Mode 7 sets up the WWI Ace battleground. Mode 8 simulates normal flying conditions; however, you begin in the air, not on the ground. Mode 9, like mode 8, starts in midair, but simulates emergency situations.

The preset modes (0 through 9) are recorded on the Flight Simulator disk. Modes 10 through 29 are user modes. No parameters have been set for these modes, so you can create your own customized modes. Each time you load Flight Simulator, the program reverts to 0 (easy flight) mode.

Creating User Flight Modes

There are three ways to create your own modes. The first method involves using the editor to enter values next to the parameters. You can start from scratch by selecting a mode (23, for example), then setting the values for the parameters. Then press the Ins (Insert) key if you intend to use the mode with those values later. You can create several modes with this method. When you have created as many as you want, press Esc. You will immediately begin flying in the last mode you created. To select another mode, enter the editor, type in the appropriate mode number next to the user mode parameter, and press Esc.

You can enter the editor at any time to modify parameters of user modes. Just enter the appropriate mode number next to the user mode parameter and change the values.

Important When you switch to a user mode for the first time, you will find it filled with random data. Flying in a mode before setting up parameters for it creates unpredictable results.

If you attempt to alter the parameters of any of the preset modes (0 through 9), that mode, with your modifications, will be entered under one of the user mode numbers. The user mode number it is entered under is the number that is the sum of the preset mode you attempted to change and ten.

For example, if you attempt to alter the altitude of the cloud layer level of mode 4, your modifications will create mode 14. Mode 14 will be identical to mode 4, but the altitude of the cloud layer will match your specifications. Any mode that was previously within user mode 14 is thus destroyed.

To avoid accidentally destroying a mode, do not put modes you want to protect in modes 10 through 19, as any changes you make to any of the preset modes will automatically write over the parameters saved under modes 10 through 19.

In creating your own modes, you will rarely want to start from scratch. In most cases, any mode you will want to create will consist of a few modifications to an existing mode. Or you may want to create several similar modes with only minor differences. The second method of creating a mode involves making a copy of a mode, then changing the values of the parameters in the copy. You can make one or more copies of any mode and modify the copies without affecting the original.

To copy a mode, use the following procedure:

Copy, then modify a mode:

- Specify the mode you want to copy by entering its number next to the User Mode parameter.
- Note the number of a vacant mode. Enter the sum of its number and 100. This will copy the original mode to the number that was vacant.
- Make your changes by modifying current parameters or adding new ones. (Press the Ins key if you plan to use the mode with those parameters again.)
- Press Esc. You will return to flight mode and can then test the mode you just created.

For example, if you want to copy and change parameters of mode 21, select mode 21. Copy mode 21 to mode 28 (a vacant mode) by specifying the sum of 28 and 100, or 128. When mode 21 has been copied to mode 28, you can change any of the parameters of mode 28 you wish.

Record the current flight position:

The third method of creating a new mode also involves altering a current user mode. As you already know, when you fly, the North, East, Altitude, Pitch, etc., values in the editor change to reflect your current position. You may, on occasion, encounter a particularly interesting situation which you would like to recreate at a later time. Pressing the Ins key while in the editor replaces the flight mode's parameter values with the current values; that is, the current parameter values are written over the original parameter values. If you are flying in any of the preset modes and enter the editor hoping to record the current values to that mode, then your current values will be recorded under the mode whose number is the sum of the preset mode you are in and ten.

Generally you will want to press Ins after creating a new user mode. Simply exiting to the flight mode will put you in the situation you set; however, the values in the parameters that reflect your flight status and position (e.g., North, East, Altitude, Pitch, etc.) change as you fly.

Store your flight modes:

Pressing the Ins key stores the values for the mode selected in a special memory area called the "Mode Library."

Each time you reselect that mode (provided you have not quit the Flight Simulator program, or, if you have, you have saved the mode to disk), the values for that mode will be transferred back from the Mode Library to the editor parameters and the situation you were in when you pressed the Ins key will be recreated.

As soon as you begin to fly, the parameter values begin to change. Pressing the Recall key resets the original parameter values from the Mode Library for the mode you are in. Or, entering the editor and typing the mode number next to the User Mode parameter has the same effect.

Pressing the Ins key is also necessary if you intend to save a mode to disk. The information "saved" on the disk is the values stored in the Mode Library. See Figure 28.

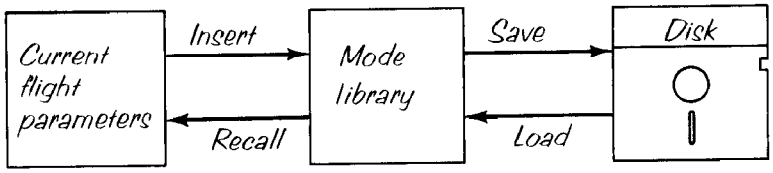


Figure 28. Saving Flight Modes

You cannot modify the parameters of the WWI Ace game or create user modes with those parameters, since doing so could provide an unfair advantage in the game. Attempting to modify or use the parameters will cause the game to revert to its standard parameters and restart the game (it will also zero out your score).

Saving User Modes

Once you quit the Flight Simulator program, all modes except modes 0 through 9 (the preset modes) are erased, unless you save them on disk. Saving a mode on disk is the second step in creating user modes.

When you have created a new set of user modes that you will want to use at a later date, you must save them on a disk. Each time you save modes, all 30 modes will be saved. Therefore, all modes on the user mode disk will be written over (except the preset modes, which always remain the same). You can use any disk that suits your system, since no special formatting is required.

Note Quitting the Flight Simulator erases all user modes except those you have saved on disk.

You cannot save user modes on the Flight Simulator disk.

To save user modes:

- Remove the Flight Simulator from disk drive A.
- Insert a blank disk or a disk that has user modes (that you don't wish to save) recorded on it into disk drive A. If the disk has a write-protect tab on it, remove it.
- Press Esc to enter the editor if you are not already there.
- Press the *S* key (for Save). All 30 modes will be saved on the disk. All modes previously saved on the disk will be overwritten with the new mode data. The message:

  MODES SAVED

  will be displayed indicating a successful save.
- Replace the write-protect tab.

Loading User Modes

To load user modes from disk:

- Remove the Flight Simulator disk from disk drive A.
- Insert the user mode disk.
- Enter the editor by pressing Esc.
- Press the *L* key (for Load). The message:

  MODES LOADED

  confirms a successful load.
- Remove the mode disk from the drive, and reinsert the Flight Simulator disk. All 30 modes are now in effect.

Disk Swapping

Databases for airports and scenery in different general geographic areas (Seattle or Los Angeles, for example) require too much memory to be stored in system memory simultaneously, so they are stored on the Flight Simulator disk. If you decide to move to a different geographic location, you must replace the Flight Simulator disk in disk drive A.

We recommend that you remove a mode disk when you are not using it and leave the Flight Simulator disk in the disk drive when you are not loading or saving modes.

If the Flight Simulator disk is not in the disk drive when you move to a different location, the message:

DISK LOAD ERROR
RE-INSERT PROGRAM DISK
AND PRESS ANY KEY TO RETRY

will be displayed. This message will also occur if there is difficulty reading the Flight Simulator disk.

Advanced Flight Techniques

Easy, auto-coordinated flight is ideal for learning flight control. However, once you have mastered the fundamentals, you will want more challenges. You can add environmental factors to simulate real flight conditions. Or select one of the other preset modes to fly in realistic conditions. Or select uncoordinated flight mode (see below) so you can learn how to control the rudder and ailerons separately. To test your skills, you can devise test situations by setting the Pitch, Bank, Heading, Airspeed, Altitude, or Throttle, Rudder, Ailerons, Flaps, or Elevators parameters.

For highly realistic conditions, reality mode can be selected. While in reality mode, you can select either auto-coordinated or uncoordinated mode. Or, you can increase the problems you encounter in reality mode by setting a low reliability factor.

Before you attempt many of these challenges, you may want to practice some advanced flight techniques as described in the following section, "Uncoordinated Flight." If you need more information on flight performance than is included here, consult the *Flight Training Handbook*. When you have mastered uncoordinated flight, instrument navigation, and a few basic maneuvers, you will have a solid foundation for any situation you can devise with Microsoft Flight Simulator.

Uncoordinated Flight

When you begin the Flight Simulator program, you are in easy and auto-coordinated flight modes. In auto-coordinated mode, the ailerons and rudder are linked. Auto-coordinated flight is the safest flight attitude. The aircraft is usually in its best aerodynamic position when it is flying in a coordinated attitude – flying straight through the air, as opposed to flying through the air slightly sideways with the airflow battering one side of it and leaving one wing in an "airflow shadow."

Control the ailerons and rudders independently:

In uncoordinated flight, the pilot controls the ailerons and rudder independently of each other. You cannot do this in auto-coordinated flight mode. To fly in uncoordinated flight mode, enter the editor and enter 0 next to the Auto-coordination parameter. This breaks the link between the ailerons and the rudder and lets you control them independently.

With auto-coordinated flight mode disabled, it is possible to fly the aircraft in uncoordinated attitudes. Slips and skids (uncoordinated maneuvers in which you fly slightly sideways) can be performed. The pilot must *manually coordinate* turns in uncoordinated mode by responding to the slip/skid indicator.

As you already know, to turn you apply the aileron, causing the plane to bank. During a bank, your wing's lifting force (which normally points straight up in straight flight) points at the bank angle. Some of the force is distributed in the upward direction, as usual. But the remaining force points sideways. It is the side force that causes the aircraft to start its turn, or to move slightly sideways through the air. The lifting force is reduced during a bank (force is deflected to the side, and the aircraft tends to lose altitude).

Once the aircraft starts flying slightly sideways due to the bank, it is in uncoordinated flight. It is no longer flying straight through the air around it. The rudder can be used to straighten out the plane again, relative to the wind coming on sideways. When the rudder is applied, the flight becomes coordinated again as the aircraft yaws. The yaw results in a change of heading. The aircraft has just turned.

If the slip/skid indicator ball (on the turn coordinator) remains centered, the aircraft is in coordinated flight; that is, the aileron and rudder are properly positioned for the turn (even though they are not mechanically linked). If the ball is to the right of center, the rudder must be adjusted to the right. Likewise, if the ball is to the left of center, the rudder must be adjusted to the left. A plane that has too little rudder applied flies through the air slightly sideways. This is known as a *slip*. If aileron only is applied, a slip results. Even in a slip, the plane will still turn. The aerodynamics of the aircraft cause a plane to tend to point into the wind. As a result, a plane in a slip will gradually turn around to a new heading to align itself with the flight path and oncoming wind. This is an uncoordinated turn and a poor flight practice.

Turn the plane by "slipping":

Slips are useful for moving the plane slightly right or left without changing heading (to line up with the runway in landing approach, for example). A bit of reverse rudder can be applied in a slip to keep the plane from turning. This is where a slip becomes useful. You can move the plane sideways without changing your heading.

Climb to 3000 feet. Apply right aileron and left rudder. The attitude indicator will show that you are banking to the right. Apply left rudder. This prevents the plane from yawing to a new heading. You are now in a slip, and although your aircraft is still pointing in the same direction, you are moving in a direction slightly to the right of the indicated direction.

Slips are useful for crosswind landings. It is essential that you land with your nose pointing straight down the center of the runway. If you land at a slight angle, in a "crab," your wheels will pull you off the runway. However, when landing in a crosswind, you must fly at a slight crab angle to compensate for the crosswind and to prevent the plane from drifting away from the runway. The plane can be aligned with the runway by adjusting the rudder, and the ailerons can be used to increase bank until the plane is flying sideways at the right rate to compensate for the crosswind. This is called a side slip. Maintain the slip until you touch down. You will land on one wheel. Do not be alarmed; that is the correct crosswind landing technique.

Slips can also be used to lose altitude, particularly on final approach. Slips, like any uncoordinated flight maneuver, put drag on the aircraft. You will lose altitude faster in a slip than in straight, coordinated flight. This can be put to good use on final approach. When you are too high, a slip can be used to lose some altitude. This practice is used very seldom on modern aircraft, but was used extensively on older aircraft, especially those with no flaps. A slip used to dissipate altitude without increasing airspeed is known as a forward slip.

Slips can be dangerous. Severe slips can stall a wing; however, a stall during a slip will bank you in the opposite direction of the turn, which tends to correct the problem.

Avoid skidding:

When more aileron than rudder is used, a slip results. When more rudder than aileron is used, a *skid* results. Skids cause the inner wing to stall, resulting in a spin or spiral in the direction of your bank. Skids have no practical value and should be avoided.

Maneuvers

There are two types of flight maneuvers: those that are performed in normal flight attitudes, but require skill, thought, and precision (for example, turns about a fixed point, figure eights, rectangular courses); and those that put the aircraft into unusual attitudes, putting severe demands on it (for example, barrel rolls, spins, and loops). Maneuvers are fun and challenging, and they help build skills that are useful in everyday and emergency situations.